Small Business Innovation Research/Small Business Tech Transfer

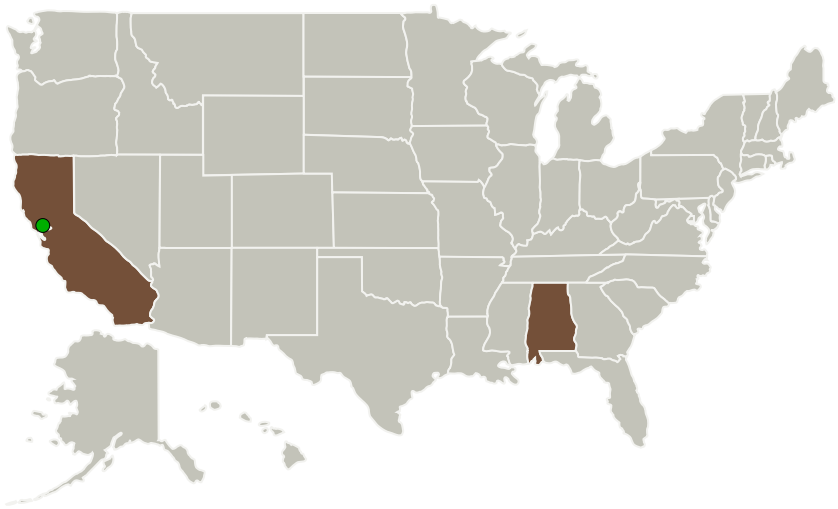
Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems, Phase I

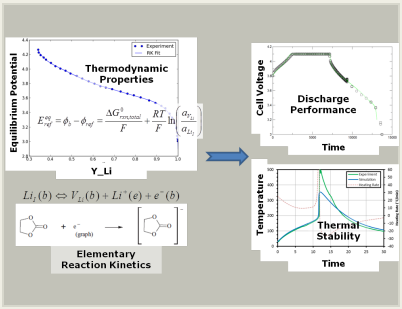
Completed Technology Project (2015 - 2015)

Project Introduction

Industry and other government agencies are advancing battery, fuel cell, and electrolyzer technology to reduce costs and increase specific power. However, NASA's unique missions with extreme conditions and difficulty in replacing batteries require even greater specific power improvements in conjunction with long life and performance at extremely high or low temperatures. Predictive models, incorporating the thermodynamics and electrochemistry that dictates device performance and degradation, are needed to accelerate development and insertion of these systems. To provide this capability, CFDRC and our collaborator Dr. Partha Mukherjee, TAMU, will develop and validate detailed models that link chemical composition and elementary reaction steps with the properties and reactions of electrochemical system constituents. The proposed electrochemical models will be based on fundamental chemical and electrochemical properties of the materials, as opposed to empirical fits of observed properties for a specific battery electrode material and electrolyte mixture or fuel cell catalyst, support, and electrolyte combination. A property database and software library will be used and extended, allowing application of the developed models in performance simulators of NASA preference. The ability of the developed models to incorporate detailed thermodynamics and electrochemical kinetics of degradation processes will be demonstrated during Phase I, with extension to additional materials and validation during Phase II. The resulting models will significantly reduce the need for iterative, trial-and-error tests of new materials to accelerate development and increase confidence in projected device lifetimes.

Primary U.S. Work Locations and Key Partners





Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems, Phase I

Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems, Phase I

Completed Technology Project (2015 - 2015)

Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
Alabama	California

Project Transitions

June 2015: Project Start

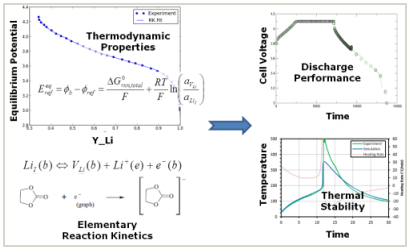
December 2015: Closed out

Closeout Summary: Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Sy stems, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/137766)*

Images



Briefing Chart Image
Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems, Phase I *(https://techport.nasa.gov/image/131675)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
CFD Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

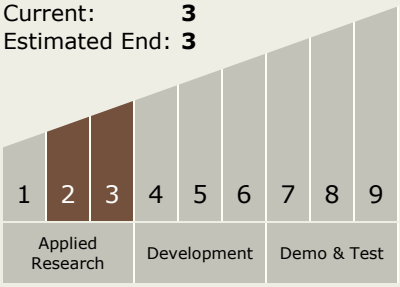
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
James V Cole

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Thermodynamically Consistent Electrochemical Models for Accelerating Development and Qualification of Power Generation and Storage Systems, Phase I

Completed Technology Project (2015 - 2015)

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.2 Modeling
    - TX11.2.2 Integrated Hardware and Software Modeling

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System